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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

WILLIAM B. GREELEY, FORESTER

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INSTRUCTIONS FOR MAKING  
TIMBER SURVEYS IN THE  
NATIONAL FORESTS

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FOREST SERVICE

WILLIAM B. GREELEY, Forester

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INSTRUCTIONS  
FOR  
MAKING TIMBER SURVEYS IN  
THE NATIONAL FORESTS

Including Standard Classification  
of Forest Types



Washington  
Government Printing Office  
1925

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# INSTRUCTIONS FOR MAKING TIMBER SURVEYS IN THE NATIONAL FORESTS

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## PURPOSE OF HANDBOOK

The purpose of this handbook is to present the policy of the service for the conduct of timber surveys and to standardize the methods used in the districts to the extent necessary to insure reasonably accurate and uniform results. Conditions in the districts differ to such a degree that in some respects standardization of methods is not felt to be desirable. It will be essential, therefore, for each district to issue supplemental instructions to its field officers based upon the principles herein outlined regarding methods not standardized by this handbook.

## POLICIES IN TIMBER SURVEYS

### Object of the Work.

The object of all timber-survey work is to obtain an inventory of the timber resources of the national forests for purposes of management, sale, protection, or exchange, and incidentally to further the development and correlation of other uses of the national forests, as, for example, recreation. In practically all cases the object is not only to get an estimate of the volume of merchantable timber, but also to obtain the data necessary for the intelligent use of the national forests, for the proper silvicultural treatment of stands, and for determining what areas need planting.

### Classification.

Roughly, timber-survey work may be classified as (1) timber sale or acquisition examinations, that is, the examination of bodies of timber proposed for sale, exchange, or acquisition; and (2) the management reconnaissance, or the work of getting the data needed for the preparation of plans of timber regulation. The methods and the standards used for each class of work will vary in accordance with the use to be made of the data. On the same project part of the area may be covered with the object of getting data for a management



plan, and part to get data for the purpose of immediate sale of the timber.

#### **Relation of Projects.**

The demand for national forest timber is increasing rapidly. For forests or regions where the opportunity to dispose of timber is large in relation to the supply, the need for timber inventories and for the preparation of management plans is acute. Under such conditions, the first responsibility of the service is to develop timber uses in an orderly way, safeguarding permanency of production and directing use first to those bodies of timber which are overmature or which from other causes are not growing satisfactorily. The formation of a definite program of sales, or cutting budget, to accomplish the objects of national forest administration is possible only after data on the location, amount, and condition of the timber on logical units of management have been obtained. The collection of such data through timber surveys and the preparation of a management plan must, under such conditions, precede sales; but usually the cruising of the first areas to be sold can and should be on standards which make further cruising of those areas unnecessary. The work on the remaining areas can often be on lower standards.

It is also necessary to cruise proposed sale areas by themselves if no management plan for the working circle is now needed or if the previous work has not been on a standard satisfactory for appraisal purpose. This need may be due to the receipt of applications or to decision that the service should try to dispose of bodies of overmature or deteriorating timber without waiting for an application.

If the resources available to a district forester are not sufficient to enable him to handle all urgent timber survey projects, the following order of priority will usually determine what projects should be undertaken and what must be postponed:

(1) Projects to prepare for sale timber needed by established industries dependent on the national forests for their supplies.

(2) Projects to obtain data for urgently needed management plans, combined with the cruising of one or more timber sale or other timber use areas:

(a) To supply established industries.

(b) To respond to an application from a new industry, selecting the area for sale preparation according to the silvicultural condition of the timber rather than the specific application.

(c) To prepare for the advertisement of reasonably accessible timber for which application has not been made but which on account of its silvicultural condition should be sold.

(3) Projects to prepare for the disposal of timber to new industries, where no additional data is needed for management plan purposes.

(4) Projects to prepare for business anticipated but not yet in the form of applications, involving either management plans or sales, or both, and not involving timber the disposal of which is urgent because of its condition.

#### **Programs and Allotment of Special Funds.**

Timber-survey work on the national forests is financed in part from a special appropriation which has been carried in the agricultural appropriation bill for the Forest Service since 1916. The language of the appropriation act for the fiscal year 1924 is as follows: "For estimating and appraising timber and other resources on the national forests preliminary to disposal by sale or to the issue of occupancy permits, and for emergency expenses incident to their sale or use." This appropriation is thus available for work connected with obtaining an inventory of the forest resources and for emergency expenses in the utilization of such resources. Under the policy of the Forest Service the appropriation is divided between getting an inventory of timber resources (timber survey) and an inventory of grazing resources (grazing reconnaissance).<sup>1</sup> The timber-survey portion is used only for getting an inventory of the timber resources in connection with timber sales and the preparation of plans of management. While it is legally possible to use the appropriation for purposes such as timber sale administration, such use will not be made of the funds unless specifically authorized by the Forester.

The Forester will allot the portion of the appropriation for timber surveys to the different districts on the basis of three to five year plans of work. Each district will submit reports as referred to in the chapter "Records and reports" and the Forester, on the assumption that the appropriation will not be changed, will prepare and issue a statement of the expected allotment to each district for the ensuing three to five year period. In so far as it is found administratively possible, the allotment to any district will not be changed beyond a possible 15 per cent reduction or except as changes occur in the special appropriation. The 15 per cent leeway is necessary in order to take care of unforeseen emergencies. Subject to the general policy and instructions issued by the Forester, the use of the money on specific timber-survey jobs will be under the

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<sup>1</sup> For use of the grazing reconnaissance money see special instructions issued by the branch of grazing, Washington office.



direction of the district forester. The Forester does not care to approve specific projects, but does wish to keep in touch with the programs decided upon by the district forester, so that if any program once decided upon and forwarded to the Forester for information is not substantially followed, notice of changes should be sent to the Forester for his information. This program should include a discussion of the relation between management reconnaissance and timber sale examinations.

#### **Duties of Forest Management and Engineering.**

All timber survey work involves engineering problems. Some surveys requires only the rough skill expected of every forester. The more intensive work, however, requires engineering technique of a high order. No timber survey work should be undertaken without consulting the district engineer; his advice should be followed with reference to all engineering phases of the work. The branch of engineering is held responsible for the character and accuracy of engineering work and for having all map work carried out in accordance with the instructions of the Federal Board of Surveys and Maps. Each district forester is responsible for getting the proper coordination between engineering and forest management. While it has generally been advisable to have the topographic mapping work done by the same crew which estimates the timber, there are often opportunities to separate the two classes of work advantageously, at least to the extent of the establishment of the primary and secondary control in advance of the actual cruise. The emphasis in all timber survey work should be on the timber inventory, and although important, the engineering phases of the work must be considered merely as a means to an end.

#### **POLICY IN MAPPING**

The Forest Service desires to complete as rapidly as possible thoroughly good base maps of the national forests, useful for all purposes. Timber survey work offers opportunities to obtain data useful in completing these maps. However, the limited funds available for timber survey work prohibit the use of these funds in the making of any better maps than are demanded by the actual timber-use needs in each case. For some purposes—as usually for management plans—very rough maps are sufficient. In other cases detailed, accurate maps are required. In no case will the map made in timber survey work be of a higher standard than the immediate requirements justify. Whatever is done in map work, however, must be consistent for



the project and in accordance with approved standards for the class of map being made.

Contour maps are expensive and will be made only where the added expense is clearly justified in the judgment of the district forester. This justification seldom exists except where large bodies of timber are to be sold and a contour map will aid materially in arriving at the correct value of the stumpage. In no event should United States Geological Survey maps of a satisfactory degree of accuracy be duplicated. Under most conditions drainage maps only should be made. If, however, a map of a higher standard is needed for other current work of the service and funds to cover the increased cost are available from other appropriations, it is obviously sound administration to fill the various needs with map of the highest standard required by those needs.

In all mapping work, special care should be taken to locate accurately streams, ridges, and possible transportation routes.

#### **KIND OF DATA TO BE COLLECTED**

The following outline indicates the character of data which should be collected for each class of timber-survey work:

##### **For Timber Sales.**

1. A base map showing at least drainages, divides, ridges, survey lines, corners, and monuments; and proposed logging improvements and boundary of proposed sale area.

2. Status of land ownership in as much detail as conditions require. Unless too complex, this should be shown as part of the base map.

3. Forest cover. Colored maps showing forest types, area, and limits of merchantable and accessible timber.

4. The estimate and report. Tabulations and a descriptive report giving the estimate and the forest description in accordance with the outline on Forms 578 a and b.

##### **For Management Plans.**

- (1) A base map showing the location of main and principal tributary streams and ridges; all land-survey lines and corners, triangulation points; and Forest Service monuments and control lines; divisions for regulation—for example, boundaries of working circles, blocks, and compartments; and roads, trails, and fences, or other improvements to the extent consistent with the scale of the map. In the usual case this base map will be made up as a compilation of existing data corrected and amplified as the result of the field work.

- (2) Status map showing ownership of lands in as much detail as is available and needed. If the ownership is not

complex, it should be shown on the base map by cross-lining; otherwise the ownerships should be shown in colors superimposed on a copy of the base map, or by some other appropriate method.

(3) Forest cover maps showing in colors a broad classification of types, age classes, and sometimes site classes. Productive and nonproductive land will always be indicated by clearly distinguishable colors or symbols. It is often necessary to present these classes of data on separate maps. In some cases some other classification than types and age classes, in the usually accepted meaning of these terms, must be used. For example, in the southern Appalachian Mountains the preparation of a management plan often requires a classification such as wrecked or salvage stands, burns, virgin, etc.

(4) Tables of total merchantable volume, which are usually given separately by age classes and sometimes by types, or with the volume of important species shown separately or by a percentage of relationship. Obviously this class of data, together with that listed under 5, must be given separately for each working circle, and sometimes it is given separately by blocks.

(5) Tables of area by types and age classes or by such other classification as will be usable in preparing a management plan. Such data should be compiled from the maps.

(6) Data for a report for each working circle describing the timber and topography and including a discussion of the factors affecting management; for example, size and quality of timber products for which it is most suitable, amount and character of reproduction and immature timber, diseases and insects, accessibility, and fire hazard.

(7) Other data sometimes made usable or essential by intensity of management, such as data on volume, age class, and types segregated by site classes (physical types; see chapter on standard classification of forest types), stand tables, and growth and yield data. Most plans of the present day do not require detailed consideration of sites. Predictions of yields are often based on general data already available for the forest types or species of the region.

#### INTENSITY OF FIELD WORK

The intensity of the field work to be undertaken for any class of timber survey will depend upon the use to be made of the results as well as upon the amount of money available. The main thing in each case is to see clearly how all of the data to be collected are to be used and to collect them in the

form in which they are most readily serviceable. It is a temptation to gather a multitude of data and to introduce many refinements into the work for which no use can be found.

#### **For Timber-Sale Examination.**

The needs for this class of work vary all the way from very extensive examinations of large areas of pulp wood in Alaska to very intensive examinations of high-priced species, such as white pine in Idaho, or white oak and poplar in the southern Appalachians. With this wide variation in needs, rigid service-wide standards are inapplicable. Usually the area to be included in the proposed sale is systematically covered by the strip or sample plot method, one or two man crews covering from 10 to 20 per cent of the area, and a map prepared on a scale of 4 or 8 inches per mile. The map and the estimate should be closely confined to the area to be included in the proposed sale.

The standard of intensity for most conditions is a 10 per cent strip estimate by two-man crews and the collection of data for a map on a scale of 4 inches to 1 mile. The costs, since the work is confined to limited areas and often high-priced men are used, will usually range from 10 to 50 cents per acre.

#### **For Management Reconnaissance.**

For small areas, where the demand for timber is heavy and where the determination of the exact location and the exact quantity of the allowed cut is highly important, a very intensive examination is justified. Usually, however, a management reconnaissance can be conducted with sufficient degree of accuracy for present purposes for from 3 to 6 cents per acre. The intensity of the survey must be determined in each case according to the needs of the situation. It will depend upon the answer to the question, How great an error can be permitted without seriously affecting the results in such factors as (1) determination of the areas of age classes, and types, or such other area classification of data as may be decided upon; (2) determination of the mature and immature volume of the stand; (3) determination of the volume or percentage of different species in the stand; and (4) determination of the limits of accessibility for the first cutting cycle?

It is, of course, recognized that some projects will involve a management reconnaissance for an entire working circle and a timber-sale examination of the particular body of timber selected for the first sale. The principles of extensive and intensive examination would then apply to the different parts of the same project.



**METHODS OF FIELD WORK****District Forester's Instructions.**

As already indicated, it is impracticable, because of widely varying conditions and needs, to prescribe universally applicable methods of performing field work. Two-man crew strip methods of estimating and mapping have through long practice become well established, and for any timber survey work to which such methods are applicable the instructions herein outlined should be followed. The instructions will apply in most cases to timber sale examinations and to all forms of intensive work. Since they will not apply, as a rule, to management reconnaissance and since some variations are necessary to meet special conditions, each district forester will prepare general or project instructions not inconsistent with these instructions and covering both the engineering and the cruising and recording features of the work. Copies of such instructions will be sent to the Forester for his information and for such action as may be necessary.

**Preliminary Examination.**

Unless the essential data have been obtained previously, a preliminary field examination will be made of all projects requiring the expenditure of more than a few hundred dollars. The object of such an examination is to determine the need and urgency of the project, in accordance with the policy previously outlined, and to obtain the data necessary for organizing the work and conducting the project efficiently. In order that the essential features may be competently passed upon, the examination should be made by the chief of party, the forest supervisor, or a qualified member of the forest force or of the district office who is familiar with timber survey, timber sale, and silvicultural practice, with appraisal methods, and with the requirements for management plans. It is better to defer a project an entire season, pending a preliminary examination, than to launch it without definite assurance that the expenditure is justified and without a well-thought-out plan for the conduct of the work. Upon the completion of the examination the examiners will notify the district forester (through the supervisor) of their conclusions on the advisability of undertaking the project. If the district forester believes the project advisable, the examiners will prepare a project plan.

**Project Plan.**

The examination should be sufficiently intensive to permit the preparation of a plan for the project which will cover—

(1) The area which should be covered by the timber survey, specifying the approximate limits of merchantable timber as a basis for adjusting the intensity of the cruise in merchantable and unmerchantable timber area. (See "Estimating.") The plan should also include recommendations for or against inclusion of alienated lands in the project.

(2) A detailed plan for control, topography, and estimate.

(3) If not covered by standing district instructions, a clear explanation of the methods of classifying and treating, with reference to the particular project, the subject listed on Form 494, i. e.:

Height class.

Site.

Forest type.

Age class.

Condition of timber.

Quality of timber.

Logging factors.

Reproduction.

Notes.

Detailed instructions, also, should be included on the application of volume tables; and on the methods of recording estimates of timber of merchantable size, by species, whether commercially important or not, by diameter breast high, and by merchantable height in feet or logs to the top diameter consistent with the volume tables to be used, and recording trees below merchantable size to a minimum of 4 or 6 inches diameter breast high.

(4) The availability of existing maps and survey-field notes for the area and the extent to which these data can be used.

(5) The size and organization of the party.

(6) Necessary equipment, transportation facilities, trail construction required, possible camp sites, etc.

(7) Instructions as to responsibility of the party chief, organization of the work, handling of personnel, relation to the fire-protective organization of the forest, current, and final reports, and filing of field data and correspondence in camp.

The engineering and mapping features of the plan will be referred to the district engineer for comment and recommendation before approval by the district forester. The approved plan will constitute the basis for the conduct of the project and will remain in effect until the project is completed, unless modified by the district forester.

#### **Surveys.**

The maps and surveys section of the National Forest Manual outlines the Forest Service standards of mapping and the methods for obtaining the degree of accuracy required under each standard. Standards are fixed for primary control, secondary control, and interior lines. The aim of these standards is

to obtain maps sufficiently reliable to be accepted as a part of the permanent service map record. The degree of accuracy attained under them will permit the use of the maps for all administrative needs. All surveys and maps made in connection with timber-survey projects will conform to these requirements. In all matters of engineering technique the advice of the district engineer must be followed unless prior approval of a different course of action has been obtained from the Forester.

#### **Scales.**

The scale of maps as originally made will be no less than 4 inches to 1 mile. Usually the field maps will be on a scale of 4 inches to 1 mile. A larger scale may be used for field maps if desired. The scale of the finished map will depend upon the amount of detail to be shown and should be made larger than 4 inches only where clearly justified by the detail to be shown.

#### **Contour Interval.**

If a contour map is necessary the standard contour interval will be 50 feet. A departure from the standard will be permitted, in the discretion of the district forester, only when, because of choppy topography or for other reasons, a closer contour than 50 feet is necessary to afford detailed map data required for some special purpose, or on long, steep slopes, where a greater interval than 50 feet will adequately depict the topography of the area and will in no way detract from the value of the map for the purposes intended. In no cases will a smaller interval than 25 feet or a greater interval than 100 feet be used.

#### **Smallest Unit of Area.**

Separate types and age classes and merchantable and unmerchantable timber areas 10 acres or more in extent will invariably be mapped. Ordinarily, areas smaller than  $2\frac{1}{2}$  acres need not be mapped.

#### **Symbols.**

The symbols standardized for the district will be used on timber-survey projects. Where features to be included on timber-survey maps have not been standardized the district should use the symbols already employed by it or devise suitable ones. The extent to which symbols will be employed to indicate features of topography that affect logging transportation should be determined upon the advise of the logging engineer. The location of cliffs, ledges, rim rock, rock slides, patches of broken rock or bed outcrops, swamps, marshes, flats, and benches should be recorded uniformly.



**Monuments.**

The instructions of the maps and survey section of the National Forest Manual will be followed in monumenting stations and marking surveys on all permanent lines and in recording the monuments and descriptions.

**Estimating.**

A record of the estimate will be kept upon Form 494 in accordance with the instructions outlined in the plan for the project.

**Standard of Accuracy.**

The standard of accuracy to be sought in estimates is 5 per cent plus or minus on areas over a section in extent and 10 per cent plus or minus on areas of a section or less. The accuracy of the estimates will be determined by comparison with check estimates by experienced cruisers as hereafter described.

**Percentage Traversed.**

Except on areas best adapted to the use of the plot or 100 per cent estimate (see "Method of Traversing Area") and in districts 7 and 8, in which the district forester will prescribe the percentage of area to be covered (subject to the minimum requirements herein given), the standards to be followed in securing estimates of the timber are:

(1) Estimate of the timber on an average of 10 per cent of the ground within the boundaries of areas on which the timber will probably be sold in the near future, locating the strips so as to cover the commercially important types and species more completely than those of minor importance. For relatively small areas (2,000 acres or less), and especially where such areas contain chiefly species of high stumpage value, the percentage covered should be increased to 15 or 20. Often in areas containing a considerable percentage of species of negative values which experience shows must be cut for silvicultural reasons, it is equally important to get an accurate estimate of such species. The advice of the logging engineer should be followed in determining the percentage of the area to be covered.

(2) Estimate the timber on from 2½ to 5 per cent of the areas containing timber not merchantable in size and timber of minor importance commercially.

(3) Traverse or plane-table burns, ridges, stands of young growth, and treeless areas to the extent necessary to obtain topographic data and type boundaries.

(4) Alienated land should be estimated or mapped only where a clear showing of need for such data can be made, or where the owners of such lands are willing to pay their fair share of the costs and it will be advantageous to the United States to have available a cruise of the land on a known standard.

#### **Estimating Unit.**

The unit of estimating in surveyed country will usually be the 40; and in unsurveyed, the hypothetical square 40 or some other convenient unit not exceeding 160 acres selected by the chief of party in consultation with the supervisor and approved by the district forester. On the purchase areas on which the rectangular form of survey has not been used the unit of estimating for the project will be kept as small as practicable, so as to conform to the practice on lands surveyed rectangularly.

If the objects of the survey will be better served by obtaining volume estimates based primarily on the types and age classes, or by compartments or subcompartments, a larger unit of area than 40 acres may be chosen at the discretion of the district forester. In most cases, however, the maximum size of the unit should approximate 160 acres.

#### **Method of Traversing Area.**

The standard method of traversing areas will be by strips at least 1 chain in width on which the trees will be tallied by diameter breast high and unit of height to a given top diameter. The advantages of the strip method are adaptability to both mapping and estimating practice, the opportunity given to systematize the courses run, and the probability that the areas traversed as a whole will represent average conditions on the tract. Its disadvantages are its inflexibility and the mechanical nature of the work. It does not tend to develop skilled cruisers.

#### **Diameters.**

It is essential that great care be taken by the crews to get the correct diameter breast high of trees on the area traversed. Ocular measurements of diameter should be made only by those proficient in judging diameter measurements. Even these should frequently check their judgment by actual measurements. The extent to which actual measurement will be done on each project will be determined by the chief of party. Except with estimators of very wide experience in the type and region, it is unsafe to take actual measurements of less than 25 per cent of all commercially important trees of merchant-



able size on the strip, preference being given to trees of the larger diameters.

Trees below merchantable size to a minimum diameter breast high of 4 or 6 inches, as may have been approved in the project plan, will be recorded in such manner as the district forester directs. Trees of smaller diameters breast high will be classed as reproduction. The standard instruments for measuring diameter and heights will be the Biltmore stick and, for the diameter of trees 40 inches or larger, the diameter tape. The Biltmore stick should be used on trees of 40 inches diameter breast high or larger only if the use of the tape is clearly impracticable.

**Heights:**

In estimating volume by board measure the best method of determining heights is to estimate the number of logs of given length in each tree of merchantable size on the area traversed, the number of logs being rounded off to the nearest number of the given length. Another method is to record the total height of each tree or the prevailing height of the timber in its relation to three or more height classes established for the project. In both instances the volume of the timber is obtained from volume tables, based in the first case upon diameter breast high and number of logs, and in the latter case on diameter breast high and total height. Heights should be taken in current work from time to time with the Biltmore stick. These should be checked by occasional measurements made with a hypsometer or by pacing windfalls.

The method to be followed in determining heights of timber of merchantable size will be by the number of logs per tree, except under the following conditions:

(1) In even-aged stands of uniform height, to which existing height-class tables are believed applicable or for which applicable tables are available or can be constructed readily, the alternative method given above may be employed in the discretion of the district forester, provided a distinct saving in cost can be effected thereby.

(2) When the material estimated is to be converted into special products, such as poles, ties, shingle bolts, etc., the estimate may be made on the basis of the appropriate market units.

(3) When the volume is to be estimated in cubic feet an appropriate method of determining and recording heights will be prescribed by the district forester.

**Quality of Timber.**

Ultimately it is hoped that the quality of timber in the standing tree may be determined by and receive a log-grade classification. Therefore this practice should be adopted in timber surveys as rapidly as the crews develop capacity for it. It is followed to some extent in the Northwest at the present time on the basis of the standard specifications for logs in the general market. The classification of logs in standing trees in accordance with these specifications require more experience than most members of timber-survey parties have had, so that for the present its general adoption is not considered practicable. When the designation of quality by log grade is for any reason impracticable, it will be the policy of the service to express quality by clear bole or number of clear logs of stated minimum length and diameter, as provided by Form 494. Estimating in terms of quality of the product is more important and more practicable on timber-sale examinations where experienced men are employed than on projects cruised by the usual timber survey crew made up partly of inexperienced men.

**Volume Tables.**

Arrangement will be made, as a part of the preparation of the project plan, to assemble volume tables for use by the crew, unless the district instructions already include suitable volume tables, or the preparation of volume tables constitutes a part of the project. Every opportunity should be taken to test volume tables now in use, with a view to determining the extent to which they are applicable to timber in different parts of the district.

The most prolific sources of error in the application of volume tables, to which particular attention should be given in inspections, are:

- (1) The use by the estimator of a different top diameter from that upon which the table is based.
- (2) Differences between the top diameter upon which volume tables are based and those actually followed in logging.
- (3) Differences between the form factor of the timber on which the volume tables were made up and that of the stand being estimated.
- (4) Differences in thickness of bark.

**Defect.**

It is highly important that members of the crews be trained in determining defect in standing timber. With inexperienced crews doubtless it will be found advisable to use an average cull factor by species based upon the judgment of the chief

of party and the logging engineer and the percentage of defect found to exist on timber-sale areas within the same region. Where individual species are very defective a separate cull factor should be ascribed to them. Where individual trees are exceptionally defective it is permissible to carry a special record of them in such a way as to indicate the percentage of defect, as by entering a percentage figure in a circle rather than the customary dot; thus (3) entered in the appropriate blank on Form 494 would mean a tree 30 per cent defective.

#### **Snags.**

Form 494 provides for the number of snags above a minimum diameter and height, the percentage of cull by species, and the extent of damage (expressed in percentage) by fire, insects, or other agencies. A record of the number of snags of sufficient size to constitute a fire menace is needed for use in prescribing fire-protective measures in timber-sale contracts. On projects which will be followed immediately by sales involving a tree-sanitation contract clause it will also be necessary, as an aid in appraisals, to have a record in the form of the number of unmerchantable diseased trees.

#### **Tallies.**

Unless other units of area are provided in the instructions for the project, tallies will be kept separately by forties, compartments, logging units, and areas of merchantable or unmerchantable timber. Separate tallies for each type and age class may be required in the discretion of the district forester, except that a separate tally of scattering timber on areas which are mapped as unmerchantable will always be required. Where tallies are not changed for type and age class, all types and age classes traversed will be indicated on the back of Form 494, with the proportion of each.

#### **Errors Likely to Occur in Estimating.**

The errors most likely to be serious in estimating are:

- (1) Inaccuracy in estimating defect.
- (2) Inaccuracy in the use of volume tables.
- (3) Mistakes in measuring or judging diameters.
- (4) Errors in determining heights.
- (5) Failure to use the correct width of strip.
- (6) Failure to include all and only trees actually within the strip.
- (7) Failure to sketch types correctly.

Steps necessary to eliminate or reduce these errors to a minimum are outlined under "Field Checks and Inspection."

The practice of allowing for cull by reducing the diameter or height of individual trees will not be followed; nor, in deter-



mining the number by which to multiply the volume of a strip to get the volume of a forty, will the volume of the strip be increased or decreased to bring it to the estimator's general impression of the forty.

#### Correction Factors.

It should be understood that in broken stands, interspersed with parks, etc., the acreage on the strip and the acreage of timber on the forty or other unit are entirely distinct. The latter is not any prescribed multiple of the former. The strip should stand by itself and its timber area and volume be computed as a basis for the determination of the total volume on the unit.

The correct number by which to multiply the volume tallied on the strip to obtain the volume upon the forty or other unit it obtained as shown below:

$$\frac{\text{acres of timber (on forty)}}{\text{acres of timber on strip}} = \text{number sought.}$$

The timbered acreage in each case is obtained from the compassman's map. For example, when the map of the forty shows 10 acres as grassland and 30 acres as timber, and 8 chains of the strip were run through grassland and 12 chains through timber:

$$\frac{30 \text{ acres}}{1.2} = 25$$

Assuming that the volume on the strip is 15,000 feet, the volume of timber on the forty would be 375,000 feet.

Where tallies are kept separately by trees and age classes and part of the forty is in one type or age class and part in another, the proper number by which to multiply the volume of each tally sheet is determined in a similar manner.

### FOREST DESCRIPTION

#### Types.

The "Standard Classification of Forest Types" contained herein will be used in naming and recording types.

#### Age Classes.

It is important that in designating and recording age classes the distinction between size, merchantability, and age be borne clearly in mind. The use of size as a constant indication of age will result in error in the case of small, scrubby, decadent, or subalpine stands. Size is given in the estimate, while

special provision for mapping merchantability should be made by the use of suitable symbols, designating merchantable in contrast to unmerchantable stands. The simplest method of designating age classes is by the use of descriptive terms, clearly understood, which cover a range of age classes readily distinguishable, such as:

Overmature, over ——— years old.

Mature, between ——— and ——— years old.

Intermediate, between ——— and ——— years old.

Poles, between ——— and ——— years old.

Saplings, between ——— and ——— years old.

Seedlings, between ——— and ——— years old.

#### **Silvical Data.**

To be of value for subsequent use, silvical data must be so expressed as to permit their being assembled in comprehensive terms and mathematical form for the whole tract. Loose, general descriptions are useless. In order to simplify the collection of these data and permit their ready compilation, Form 494 provides for a statement of the condition of the timber, i. e., thrifty, mature, and decadent, in terms of percentage of the total merchantable volume; and for a statement regarding reproduction in terms of density of stocking, i. e., no reproduction, one-third stocked, two-thirds stocked, and fully stocked. The form provides also for a statement of the proportion of the total reproduction on the area represented by each species. Ordinarily it will be necessary to report reproduction only in uneven-aged stands or where it constitutes the cover.

#### **Logging Factors.**

Observations on ground cover, ground surface, and topography should be made from the standpoint of their effect upon logging. Reproduction, so far as it is a factor in logging, should be considered in recording undergrowth. Form 494 provides for a brief statement on logging factors, under which is to be given the amount of undergrowth and windfall expressed in terms of density; of bowlders and broken rocks expressed in terms of quantity; and such other factors as will indicate the ease or difficulty of the logging. To be of greatest value, notes obtained on logging factors other than those specifically provided for on the form should conform to those desired by the logging engineer and incorporated in the project plan.

#### **YIELD AND INCREMENT**

So far as practicable the data obtained on timber-survey projects will be utilized in the construction of yield tables showing the actual yield of the watershed covered. Actual or em-

pirical yields of the area in question may be obtained from data on even-aged stands where the tallies are kept separate by type and age classes and in uneven-aged stands upon which the area of growth below merchantable size is determined.

In even-aged stands the tallies of each age class in each type are combined to give the average volume per acre of the age class. Each age class will thus give a point on a curve of yield for the area covered.

### FIELD CHECKS AND INSPECTION

Provision will be made in all project plans for specific field checks and inspection. Effective checks not only on the estimates, but on the maps and notes obtained, are indispensable. These checks should be made during the progress of the work by the chief of party or a member of the party especially fitted for it, by the supervisor or his representative, and by members of the district office. Every man connected with timber surveys should understand that his work may be checked at any time.

It is the duty of the chief of the party to have frequent check estimates made and to instruct members of the crews in all phases of their work. In order to insure that adequate attention is given to these important features of the project, each party chief should be required to make or have made a mechanical check estimate, with the original crew, on at least 3 per cent of the strips covered, and to spend at least one-half day with each crew every 10 days for the purpose of instructing the men and checking up other phases of their work. The essential reason for the conduct of a mechanical check is to keep the accuracy of the estimates at a high standard by affording a thoroughly accurate basis for checking the work of the crews and pointing out to them the particular respects in which their estimates are in error. In order that the check estimate may serve this purpose, exact methods, such as chaining width of strip at frequent intervals, obtaining heights by hypsometer, etc., will be used as far as possible. The check estimate may be used also, as a basis for the correction of original estimates the accuracy of which is not within the standard prescribed, but its use for this purpose is considered incidental to its value for the maintenance of a high standard of accuracy by the crew.

In obtaining a check on the general efficiency of the crews particular attention will be given to the following points:



(1) That the vertical and horizontal ties at the ends of the strips are within the degrees of accuracy prescribed by the plan.

(2) That the crews are exercising the proper care in the width of strips within which the timber is tallied.

(3) That the crews understand and are obtaining satisfactory results in platting topography.

(4) That proper care is taken in the measurements of diameter and height, and in distinguishing species and, where recorded separately, age classes such as "yellow pine" and "black jack."

(5) That proper allowance is made for defect.

(6) That the quality of timber is properly ascertained and recorded.

(7) That the acreage correction factor is correctly applied.

(8) That the volume tables in use are applicable.

(9) That the silvicultural condition of the timber is correctly interpreted and recorded.

(10) That there is full understanding and proper recording of the important logging factors.

(11) That notes required by the project plan and Form 494 are understood and properly entered.

Obviously, in the larger parties the chief of party must have assistance to follow the work of the crews so closely. Arrangement for this assistance can be made by the assignment of an assistant chief of party or by using for this purpose well qualified members of the crew. Checks or inspection made by the supervisor or representatives of the district office will not in any degree lessen the obligation of the party chief to meet the requirements above prescribed. Such checks will supplement the minimum required of the party chief.

It is essential that early in the progress of the project a logging engineer or other qualified timber appraiser visit the party in order to give advice on all factors relating to the estimate and logging. He should conduct such checks as will satisfy him that the data required by the project plan as it relates to the estimate and logging factors are understood thoroughly and recorded properly. Such additional inspection will be made from the engineering and silvicultural points of view as may be needed to insure a high standard of work.

#### **PROGRESSIVE STEPS IN TIMBER-SURVEY PROJECTS**

In general, the progressive steps by which data are obtained for the completion of timber-survey projects are as follows:

**Map Work.**

(1) Before field work begins a camp map is started, ordinarily on a scale of 4 inches to 1 mile. The best possible paper mounted on cloth should be used, since this map is preserved as an important part of the permanent project record and is of great value in subsequent work. The following data, if available, should be plotted upon this sheet after the polyconic projection is outlined.

(a) Triangulation data from the U. S. C. and G. S.

(b) Triangulation stations, traverses, and bench marks from the U. S. G. S. and U. S. F. S.

(c) Any accurate survey data which are monumented by other Government bureaus or private enterprises (Reclamation Service B. M.'s, R. R. surveys, etc.)

(d) General Land Office survey lines, if tied to the more accurate control points.

(e) Status of land.

(2) Copies of all available control data, including field notes of the surveys plotted upon the camp map, General Land Office surveys, etc., are obtained before entering the field.

(3) A "progress map" covering the area is started upon any convenient scale. This is to show graphically the progress of the work currently. This map is merely a skeleton outline of the area upon which is plotted currently, with any suitable legend, the field work done by each crew. Its success depends upon how vividly it portrays the progress and status of the work. Usually this map is on a smaller scale and shows less detail than the camp map.

(4) The field control, both primary and secondary, as indicated in the project plan, is run and monumented, computations and adjustments are made, and the work is accurately plotted upon the camp map.

(5) Field sketching plats are prepared by the crews on a predetermined scale (not less than 4 inches to 1 mile), adjusted to the control, and submitted to the draftsman or party chief who transfers the topographic and cultural data to the camp map. All other topographic and cultural data available, of sufficient accuracy to be of value, should be entered upon this map.

(6) A project type map (and if desirable, site quality, age class, and merchantable area maps) is made up currently in camp, the types being shown by appropriate colors or symbols. This map may be combined with the camp map whenever clearness and neatness will not be sacrificed.



In the case of surveys for management plans, the division in blocks and compartments is made as the work progresses and is entered currently on the camp map.

**Estimates.**

(1) If volume tables are not already available they are prepared from taper measurements which must be obtained by the crew.

(2) The timber on the areas traversed by the crews is tallied by diameter and number of logs, height class, and unit of product, or cubic-foot unit, as the case may be, for each forty or other area selected; the percentage of defect is estimated; and the area of timber on the strip is recorded. The area of timber on the forty is later computed from the map.

(3) From the above are computed:

(a) The gross and net volume of each species (or group of species) on the area traversed. If age classes for a species have been tallied separately, as, for example, "yellow pine" and "black jack," the volume of each such age class will be computed by itself, by the use of different volume tables if available.

(b) The net volume of each species (or group of species) on the forty or other unit.

(c) The total net volume on the forty or other unit.

**Logging and Silvical Data.**

Notes are kept currently on Form 494 on the condition and quality of the timber, reproduction, and factors affecting logging. The major data under these heads are recorded by general descriptions, which lend themselves to convenient summarizing by forty, section, township, logging unit, compartment, or other division.

## RECORDS AND REPORTS

**Project Reports.**

A separate report and map (or maps) should be prepared for each timber survey project of whatever class. Copies of such reports should be sent to the Forester as soon as completed. Copies of the maps need not be sent except in connection with timber sale reports or management plans, or as they may be requested. Timber-sale reports should follow Form 578a and 578b.

A project report covering the results of the timber survey will be prepared as soon as the field work is completed. For the intensive projects, the chief of party should prepare in report form all data collected in connection with the project. Upon him rests the responsibility of properly compiling the map and

estimate data and coordinating the notes obtained by the crews and by him independently on the condition and quality of the timber, logging factors, and other data, and on such special problems as have arisen in connection with the project. Logging engineers and other forest officers familiar with the area should add to the data compiled by the chief of party and render him such assistance as he may need in the preparation of a complete report for the project. Unless the material which is to be included by the chief of party in the project report and the form in which it should appear are prescribed in the district timber-survey instructions, the district forester will prescribe them for each project. This can be done best in outline form.

#### Map Data.

Tracings in township units will be made from the finished camp map according to directions in the maps and surveys section of the National Forest Manual. Photographic white prints from these constitute the filing maps. The boundaries of the timber types will be entered originally on each white print of the topographic tracing and this map colored according to the standard legend to constitute the cover type map. In addition to type data numbers (or names) and boundaries of logging units, the names and boundaries of blocks, compartments, etc., will be entered on the white print of the topographic tracing in red ink according to the standard legend.

So far as is practicable, all data will be compiled in the field as soon as possible after they become available; and when this is impracticable, compilation will be completed before the beginning of the following field season. This is necessary—

- (1) To make data immediately available for use.
- (2) To obtain the obvious benefits of compilation while the data are fresh in the minds of the men.
- (3) To discover errors and omissions while there is the best opportunity for correcting them.
- (4) To prevent the loss of important data through sudden changes in personnel.
- (5) To prevent lost motion in ultimately formulating working plans.

In addition to reducing to a minimum the work of preparing the project report, the object should be to leave all data, notes, etc., in such form that a new man taking over the work will have the full benefit of what has already been done.

If final maps are to be prepared in the office of maps and surveys at Washington, the field data, with necessary corrections, should be traced on tracing or linen paper, with topography and culture on one sheet and type lines, etc., on a second.



From those tracings, the office of maps and surveys will prepare photolithographic prints of any class of maps that falls within the standard printing list and photographic prints of other classes of maps needed.

If final maps are to be prepared in the district office, the district project plan should outline the particular method to be followed in camp compilation.

#### **Estimate Data.**

Estimates should be computed during the field season if practicable. This affords a check upon the completeness of the sheets and allows a revision of methods used if necessary. All sources of error must be carefully watched and important steps in computations checked, preferably by a second person.

Estimates may, in the discretion of the district forester, be tabulated, placed on separate copies of the topographic base (by putting them on separate tracings which can be superimposed over the topographic base and printed in one operation), or placed on a plain sheet as a graphic table to be bound vis-a-vis to the topographic map.

For convenience in stumpage appraisals or in the preparation of management plans, estimates will be summarized by blocks, compartments, and logging units or by types or age classes or such other units as may seem advisable. In surveyed country they will also be summarized by sections and townships.

In order to put the estimate data to its highest use and to permit a later adjustment of it if necessary, the following summaries will be of value:

- (1) The average number of logs per thousand feet board measure, for each species, worked out from volume computations.
- (2) A summary estimate by log grades or other quality classes.
- (3) The volume of inferior species in the smaller sizes or of commercial species in the smaller sizes where desirable.
- (4) The volume of all abnormally defective trees to which average cull factors are not applicable.
- (5) Taper tables upon which a revision of the estimates may be made in case closer utilization is obtained than that upon which the estimate was based.

Further summaries by appropriate units, such as the number of trees by species and diameter classes, the average percentage of defect by species, and the number of snags and diseased trees, may also be found desirable in localities where these factors are an important feature.

**Descriptive Data.**

The descriptive portion of the report will cover all points essential to a complete understanding of the area from a silvicultural and logging standpoint which are not given on the maps or in the estimate tabulations. It should be brief and specific, presenting information in tabular form whenever possible. Photographs may often be used to good advantage. A diagrammatic map should always form a part of the report, showing the outlines of the project and the principal control lines run.

The following outline for this portion of the report is suggested as covering the more essential points. If further factors are necessary for a complete understanding of conditions, they should be included.

(1) Introduction.

(a) History and personnel of the project including size of crew and date of beginning and closing of field work, methods of work, organization, percentage of area estimated, unusual difficulties, etc.

(b) General location of project.

(c) Unit divisions.

(2) Status and ownership.

(3) Silvical description (compiled from Form 494).

(a) Brief description of each type and age class, with the proportion and area of each.

(b) The percentage of thrifty, mature, and decadent timber, and the average number of trees by species and diameters per acre suitable to be left in marking.

(c) The percentage of timber killed or damaged by fire, insects, or other agency, with a statement of the nature of the damage.

(d) The percentage of each degree of stocking with reproduction; occurrence, size, etc.

(4) Logging data. A record compiled from Form 494 and including a brief discussion of the abundance of undergrowth, windfall, bowlders, broken rock, and other surface or topographic factors which have a direct bearing upon logging.

(5) Recommendations for management. If desirable, the chief of party may be requested to submit recommendations concerning the future management of the area, including:

(a) Rotations and cutting cycles by types.

(b) Silvicultural systems.

(c) Areas most in need of cutting in the order of their need.

(6) Standards. The report should show:

(a) The extent to which the work actually measured up to the standards specified.



(b) The extent to which the estimating and mapping was checked currently while the work was in progress.

(c) The final results from the standpoint of quality, accuracy, and reliability.

(7) Costs. A record by major lines of work will be kept of the current costs on each project and included in the report. This record will be in sufficient detail to permit an annual report to the Forester on Form 446 by fiscal years.

The cost report will include at least the following data:

(a) Name of forest, project, and year of completion.

(b) Gross and net area of project.

(c) Division of project area into—

1. Area covered by less than 1 per cent cruise.

2. Area covered by 1 per cent to 2 per cent cruise.

3. Area covered by 2 per cent to 5 per cent cruise.

4. Area covered by 5 per cent to 10 per cent cruise.

5. Area covered by 10 per cent or better cruise.

(d) Character of map, including number of miles of control run and the average cost per mile.

(e) Costs per acre for control, mapping, estimating, miscellaneous, and total.

(f) Total cost of project.

#### **Periodic Reports.**

A general report from each district forester is required at intervals as called for by the Forester, but usually at periods of from three to five years. This report will give a general perspective of the timber survey work, past and future, with discussion of the classes of work needed, a discussion of specific projects in prospect, and recommendations for the allotment of funds from the special appropriation for this work for the ensuing three or five year period. This report will be a program based upon a showing of actual need from which the Forester can compare one district with another and decide upon the distribution of funds. It should include a summary of the cost reports of past projects, their classification, and a rough estimate of the acreage and costs of work foreseen for the future.

#### **Annual Maps.**

Annually on February 1, or as soon thereafter as practicable, each district forester will send to the Forester small-scale, unmounted maps of those forests upon which intensive timber survey work<sup>1</sup> has been carried out during the preceding

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<sup>1</sup> This will include all areas cruised 5 per cent or better.

calendar year. The projects will be named, and the date or year written within the boundary limits of each project. Areas of less than one section (640 acres) need not be reported. The data so submitted will be transferred in the Washington office to the cumulative map records on file, and unless return of the maps sent in is specifically requested, they will then be destroyed.

#### **Statistical Report.**

Statistics of timber survey work are included in the annual statistical report (Form 446) prepared each calendar year.

#### **Records.**

All of the original field sheets of the timber-survey work of whatever class except the original compiled field maps, which may be retained in the district forester's files if they will be of most value for general purposes in that place, should be filed in the supervisor's office. Duplicates of the data in summary form, for the major projects, will, of course, be retained in the district forester's files. It is important that the district ranger be furnished with complete data collected by timber survey crews.

### **ORGANIZATION OF WORK**

The district forester is responsible for the proper conduct of timber survey work in the same way as for other activities within his district. Because timber surveys involve the work of both forest management and engineering, his duties as a coordinator are essential and require personal attention to insure success. So far as possible, it is desirable to have timber survey projects undertaken, managed, and completely controlled by the forest supervisor. Past experience indicates that this is feasible only on small projects requiring small crews or for management reconnaissance where extensive methods are used.

Where intensive work is required over large areas which require large crews for relatively short periods and involve engineering technique, it becomes necessary for the district forester to assume a very direct responsibility for the work. Such projects require special crews to be shifted between forests in a way which prohibits turning over the full responsibility to the supervisor. The exact relation of such crews to the local forest organization and the responsibility of the forest supervisor in such cases must be prescribed by the district forester.

**Crews.**

Since funds are limited and the season of field work covers only a part of the year, the use of some temporary men for timber survey work is usually a necessity. The two-man-strip-crew method has been used largely because satisfactory results can be obtained by inexperienced men. It has long been a recognized policy of the Forest Service to employ for this work, so far as possible, students from the various forest schools of the country. This policy should be continued and a special effort made not only to train these men but to interest them in the work of the Forest Service. Where possible, at least 40 per cent of each crew should be made up of men with at least one season's previous experience. Where other methods than the two-man-strip-crew method are used a higher percentage is desirable.

**Forms.**

Forms 878 (white paper), 878a (tracing linen), 878b (imitation vellum), and 878c (celluloid) have been adopted as standard for all classes of map work in connection with timber-survey projects, and Form 494 for recording the estimate and silvical and logging data. Aluminum Tatum holders of suitable size will be provided for use with these forms and may be had upon requisition to the property clerk. The use of other forms for mapping and recording estimates or for silvical and logging data will be permitted where the standard forms do not meet the special requirements of the work. Each district may, for example, adopt for camp use such additional forms, estimate summaries, by logging units and townships, and forms for requisitioning and invoicing supplies and equipment from the supervisor's office as will simplify the compilation and camp duties of the party.



# STANDARD CLASSIFICATION OF FOREST TYPES

(Revised April, 1925)

The following standard classification of forest types will hereafter be the basis for all descriptive and mapping work in the national forests—including grazing work as far as is possible without departure from the approved type classification for grazing reconnaissance. It will be used in boundary, timber survey, timber sale, and general administrative work, and in all agricultural classification work except soil classification proper.

The classification herein outlined is based upon the present composition of the stand, regardless of whether this composition is the ultimate cover on the site or merely a temporary cover resulting from some interference with natural conditions. Where a succession of types is known to occur, either the ultimate type or one of the stages in the succession which, as far as can now be foreseen, will be perpetuated in forest management, may, if desired, be mapped or used for purposes of management in addition to the present cover.

No attempt has been made to provide for all possible combinations of species, but a rather broad practical division has been used. Only such types as occupy sufficient area to be of importance in forest management have been included.

The name is taken wherever possible from the most distinctive commercial species or key tree occurring in the type, whether or not most of the stand is of this species.

The presence or absence of key trees or combinations of trees will often be found helpful in determining how to classify any given stand. Keeping in mind the tree or trees which will be favored in cutting and the conditions which these trees require for successful growth will also assist the field men in distinguishing types.

The percentages given in the type descriptions are percentages of the number of the trees 8 inches and over in diameter, or of the trees which form the main stand and those which it is reasonable to suppose will eventually come up into the main stand. Thus, for example, in the Engelmann spruce type the young growth is often predominantly fir, alpine, or



cork bark, most of which dies off before it becomes large enough to form part of the main stand. When, in a very mixed stand, the proportion of no one species comes up to the proportion named in the definition, the area will be thrown into the type which it most resembles, or the prevailing type in the immediate locality.

Burns, except for repeatedly burned areas which contain neither reproduction, grass, nor brush in appreciable quantities and are classified as barren, should not be classified as a distinct type. The presence of reproduction or burned timber, or both, is sufficient to make possible their mapping in accordance with the following classification. There is no objection, however, to indicating the area of the burn, if desirable or necessary by a combination of the burn and type symbols.

The terms cover type, temporary type, permanent type, and physical type are used with the following meaning:

A cover type is a forest type now occupying the ground. The term conveys no implication as to whether the type is temporary or permanent or one which we shall strive to maintain under forest management.

A temporary type is a forest type which has come in as a result of some interference with natural conditions, such as fire or lumbering, and which will eventually, if nature is left undisturbed, be replaced by a different type.

A permanent type, or natural type, also called ultimate or climax type, is a forest type which eventually will take possession of and perpetuate itself on any given area if natural conditions are undisturbed.

A physical type is understood to be an area considered with reference to its forest-producing power, as determined by the physical factors of the site. It refers to the land and not to the stand, although the stand, particularly in the case of permanent types, may be an excellent indication of the physical type, and is synonymous with "site" or "locality."

No standardization of physical types is being attempted at this time, since it is felt that further investigations are necessary to place such a classification on a sound basis. There is no objection, however, to the use by any district of such types, in addition to the forest type classification called for here, provided it is believed that such a classification is necessary and of practical value, and provided the data can be obtained without overloading timber-survey crews.

## DESCRIPTIONS OF TYPES

## TREELESS LAND

There is no clear line of demarcation between trees and shrubs, and in this classification, which is purely for practical purposes, no attempt is made to draw a fine distinction between them. Accordingly, under "Treeless land" are included three types—"Brush," "Sagebrush," and "Chaparral"—which often are composed partly or entirely of individuals having tree form, but so small and stunted that the types in which they occur are classified ordinarily as treeless.

**Barren (B).****All districts.**

An area too rocky, too exposed, too arid, or at too high an elevation to support trees or grass or more than a very scattering growth of herbs and shrubs; or an area so repeatedly burned that it contains neither reproduction, grass, nor brush in appreciable quantities.

**Grass (Gr).****All districts.**

An area, such as a park, mountain meadow, or treeless ridge, whose principal vegetation is grass and other herbs.

**Cultivated (Cl).****All districts.**

An area now under cultivation or lying fallow.

**Chaparral (Chp).****District 5.**

An area too arid to support good tree growth, but bearing a permanent cover of shrubs or stunted trees, occurring in southern California.

**Sagebrush (Sgb).****Districts 1, 2, 3, 4, 5, and 6.**

An area whose principal vegetation is sagebrush.

**Brush (Br).****All districts.**

All other areas the present cover of which is a stand of shrubs or stunted trees.

**Muskeg.****Districts 2 (Lake States) and 8.**

An area with a deep peat-like soil supporting a cover composed largely of moss with some herbs and grass and an occasional stunted tree.

## WOODLAND

An area, usually at the lower altitudinal limits of tree growth, whose crop when mature is a stand of trees, ordinarily

open, usually short, branchy, and crooked, most of which are fit only for cordwood, fencing, etc.

### Piñon-Juniper (PJ).

Districts 2, 3, 4, and 5.

A stand composed of approximately 80 per cent or more of piñon and juniper in varying proportions.

*District 2.*—Piñon (*Pinus edulis*), Rocky Mountain red cedar (*Juniperus scopulorum*), and one-seed juniper (*J. monosperma*) are the chief species, often with some of the Rocky Mountain white oaks and western yellow pine.

*District 3.*—Piñon, Mexican piñon (*P. cembroides*), single-leaf piñon (*P. monophylla*), alligator juniper (*Juniperus pachyphloea*), one-seed juniper, Rocky Mountain red cedar, and Utah juniper (*J. utahensis*) are the chief species, often with some oak and western yellow pine.

*District 4.*—Single-leaf piñon, Utah juniper, one-seed juniper, and Rocky Mountain red cedar are the chief species, often with some Gambel oak and western yellow pine.

*District 5.*—Single-leaf piñon and Utah juniper are the chief species, often with some western juniper (*J. occidentalis*) and Jeffrey pine.

### Juniper (J).

Districts 1, 2, 4, 5, and 6.

A stand composed of approximately 80 per cent or more of any species of juniper with very little or no piñon.

*Districts 1, 2, and 4.*—Rocky mountain red cedar is the chief species, usually with some limber pine, western yellow pine, or Douglas fir.

*District 5.*—Western juniper is the chief species, often with some Jeffrey pine and western yellow pine.

*District 6.*—Western juniper is the chief species, often with mountain mahogany, and sometimes with a little western yellow pine.

### Oak (O).

Districts 2, 3, 4, 5, and 6.

A stand composed of approximately 60 per cent or more of any species of western oaks.

*District 3.*—Emory oak (*Q. emoryi*), Arizona white oak (*Q. arizonica*), blue oak (*Q. oblongifolia*), and whiteleaf oak (*Q. hypoleuca*) are the chief species, often with some alligator juniper, Mexican piñon, and other species.

*Districts 2 and 4.*—Gambel oak is the chief species, and is usually pretty scrubby.

*District 5.*—California black oak (*Q. californica*), California blue oak (*Q. douglasii*), canyon live oak (*Q. chrysolepis*), coast live oak (*Q. agrifolia*), highland live oak (*Q. wislizenii*),



valley white oak (*Q. lobata*), and Oregon white oak (*Q. garryana*) are the chief species, often with some digger pine, madrone, and occasionally some knobcone pine, Coulter pine, Jeffrey pine, western yellow pine, and other species.

*District 6.*—Oregon white oak is the chief species, sometimes pure but more often mixed with California black oak, tan oak, madrone, Oregon myrtle, etc.

### Scrub Oak (ScO).

### District 2 (Lake States).

A stand containing a mixture of scrubby red, black, and scarlet oaks, with an occasional white oak, and some jack pine, Usually on sandy soil intermediate between that characteristic of the jack-pine and Norway-pine types.

### Digger Pine (DP).

### District 5.

A stand containing approximately 40 per cent or more of digger pine, often mixed with various oaks, Coulter pine, western yellow pine, and other species. Occurs on any sites below the western yellow pine type.

### Scrub (Sc).

### District 8.

An open stand of stunted, limby, defective trees of no present value, with a dense understory of blueberry and other shrubs and a ground cover of hellebore and skunk cabbage. Occupies swamp-like soils. All tree species of the region are usually represented in the stands.

## TIMBERLAND

An area whose crop when mature is a more or less dense stand of trees which may furnish sawlogs, ties, telegraph poles, etc.

### Yellow Pine (YP).

### Districts 1, 2, 3, 4, 5, and 6.

A stand containing approximately 50 per cent or more of western yellow pine, except where sugar pine is the key tree. Usually on dry well-drained sites at the lower altitudinal limit of timberland or exposed south and southwest slopes at higher altitudes.

*District 1.*—The principal species in mixture are Douglas fir, western larch, and lodgepole pine.

*District 2.*—The principal species in mixture are Douglas fir, white fir, blue spruce, and lodgepole pine.

*District 3.*—The principal species in mixture are Douglas fir and white fir, and rarely blue spruce.

*District 4.*—The principal species in mixture are Douglas fir, white fir, western larch, and lodgepole pine. An exception may



be made in the case of distinct yellow-pine land containing less than 50 per cent of yellow pine, which may be mapped as yellow pine.

*District 5.*—The principal species in mixture are Jeffrey pine, incense cedar, sugar pine, Douglas fir, and white fir.

*District 6.*—The principal species in mixture are western larch, Douglas fir, white fir, lowland white fir, lodgepole pine, and sugar pine.

### Jeffrey Pine (JP).

District 5.

A stand containing approximately 40 per cent or more of Jeffrey pine. Western yellow pine and white fir are often abundant, and there is usually some Coulter pine, incense cedar, or other species. At either low or high elevations, but almost invariably on the drier, less favorable, and more exposed sites.

### Sugar Pine-Yellow Pine (SP-YP).

Districts 5 and 6.

A mixed stand in which sugar pine is the key tree forming approximately 15 per cent or more of the stand, and in which yellow pine and incense cedar are its usual associates. Other species which occur in varying proportions are white fir, Douglas fir, bigtree, and Jeffrey pine. Such areas will be included in this type even though otherwise confirming to the definition of the yellow-pine type. Usually at moderate elevations and on favorable sites between the western yellow pine and fir types.

### Sugar Pine-Fir (SP-F).

District 5.

Distinguished from the sugar pine-yellow pine type by the absence of yellow pine. Species in mixture are Douglas fir, white fir, and a very little incense cedar; at higher elevations, red fir (*A. magnifica*). The type occurs chiefly in California north of the point where the Sierras lose their distinctive crest.

### Western White Pine (WP).

District 1.

A stand in which western white pine is the key tree, forming approximately 15 per cent or more of the stand. In the northern part of the range of this type, at medium elevations, hemlock is the predominant tree, frequently outnumbering the white pine even in young stands; at higher elevations in the same region Engelmann spruce and alpine fir are the chief associates. In the middle of its range white pine occurs nearly pure or with Douglas fir as its chief associate, and with hemlock, white fir, larch, and sometimes lodgepole pine in mixture.

In the southern part of the range of this type white pine is less important numerically than farther north. Here in young stands white pine occasionally forms 50 per cent or more of the stand, but usually the predominant trees of the type are white fir and cedar, with Douglas fir and larch in mixture, a little yellow pine on the drier knolls, and sometimes in young stands lodgepole pine.

**Lodgepole Pine (LP). . Districts 1, 2, 4, 5, and 6.**

A stand containing approximately 50 per cent or more of lodgepole pine, usually nearly pure, but sometimes in mixture with other species.

*District 1.*—The principal species in mixture are Douglas fir, Engelmann spruce, alpine fir, and western larch.

*District 2.*—The principal species in mixture are Douglas fir, Engelmann spruce, alpine fir, blue spruce, bristlecone pine (*P. aristata*), and limber pine (*P. flexilis*).

*District 4.*—The principal species in mixture are Douglas fir, alpine fir, and Engelmann spruce.

*District 5.*—The principal species in mixture are white fir, red fir, and occasionally white pine. Stands with less than 50 per cent of lodgepole pine should be classed as the subalpine or fir type.

*District 6.*—The principal species in mixture are Douglas fir, alpine fir, yellow pine, lowland or white fir, mountain hemlock, western larch, and silver fir. The type occurs along the ocean beach, on the pumice flats of the central Oregon Plateau, and at the higher elevations, as in the other districts.

**Lodgepole Pine–Douglas Fir (LP–DF). District 4.**

A stand containing at least 60 per cent of these two species, but insufficient quantities of either one to make logical a more distinctive classification. Other species usually in the mixture are Engelmann spruce and alpine fir.

**Bristlecone Pine (BP). District 2.**

A stand containing approximately 60 per cent or more of bristlecone pine, often in mixture with limber pine, lodgepole pine, Engelmann spruce, blue spruce, Douglas fir, and white fir. usually on dry, rocky, wind-swept sites at the higher elevations.

**Limber Pine (LbP). Districts 1, 2, and 4.**

A stand containing approximately 60 per cent or more of limber pine, seldom pure, usually in mixture with lodgepole pine, Douglas fir, Engelmann spruce, and alpine fir. At medium elevations, usually on poor sites and dry, warm exposures in limestone or sandstone soil.

**Jack Pine (JP).****District 2 (Lake States).**

A stand containing approximately 50 per cent or more of jack pine, occasionally mixed with red pine and often with a number of species of scrubby oaks. On the driest, sandiest soils.

**Red Pine (RP).****District 2 (Lake States).**

A stand containing approximately 50 per cent or more of red pine (*P. resinosa*), sometimes mixed with jack pine, white pine, hemlock, and several species of oak. On dry, sandy soils, slightly better than those characteristic of the jack-pine type.

**White Pine (WP).****Districts 2 (Lake States) and 7.**

A stand containing 50 per cent or more of eastern white pine, often mixed with hemlock, hardwoods, and red pine, jack pine, or pitch pine. In the Lake States it occurs on moderately moist, well-drained soils of better quality than those characteristic of the red pine type. In district 7 it occurs on well-drained, moderately dry to fresh soils, open by past cutting, by temporary use as pastures or fields, or by other causes.

**Pitch Pine (PP).****District 7 (Southern Appalachian).**

A stand composed of 50 per cent or more of Virginia, pitch, or table mountain pines, pure or more commonly associated with dry-site hardwoods, such as black, scarlet, and chestnut oaks, black gum, and chestnut. It is differentiated from the oak types by the presence of pines. It occurs in the Appalachian and Cumberland Mountains from 2,000 to 5,000 feet elevation, on ridges, dry flats, and slopes. Virginia pine (*P. virginiana*) occurs frequently in pure or nearly pure stands on old fields in the mountains and throughout the Piedmont Plateau, from Maryland to northern Georgia, below 3,000 feet elevation.

**Shortleaf Pine (ShP).****District 7.**

A stand containing approximately 50 per cent or more of shortleaf pine, sometimes pure but more often in mixture with various oaks and other hardwoods and sometimes with loblolly pine. It usually occupies the drier slopes.

**Longleaf Pine (LlP).****District 7.**

A stand containing approximately 80 per cent or more of longleaf pine, sometimes mixed with slash pine or loblolly pine, and with an undergrowth of black jack and other oaks. It occurs usually on the drier, sandier, soils.



**Slash Pine (SLP).****District 7 (Florida).**

A stand containing approximately 60 per cent or more of *caribaea*), often in mixture with longleaf pine and swamp hardwoods. It usually occurs on low ground near water on damp, sandy soils.

**Sand Pine (SaP).****District 7 (Florida).**

A stand composed chiefly of sand pine (*P. clausa*) usually nearly pure, with an undergrowth of brush and scrubby oaks. It occurs on dry, sandy sites, often of very poor quality.

**Douglas Fir (DF).****Districts 1, 2, 3, 4, 5, and 6.**

A stand containing approximately 60 per cent or more of Douglas fir.

*District 1.*—The principal species in mixture are yellow pine, lodgepole pine, and western larch. Usually at the lower or medium altitudes, either at the lower limit of timberland or just above the yellow-pine type. Occurs also on north slopes above the white-pine type. The distinction between the larch Douglass fir type and this type is the presence of at least 10 per cent larch in the former. A mixture of 25 per cent or more yellow pine would justify typing as yellow pine.

*District 2.*—The principal species in mixture are yellow pine, lodgepole pine, limber pine, white fir, and blue spruce. Usually at medium elevations and on poor or fairly favorable sites and moderately warm exposures.

*District 3.*—The principal species in mixture are yellow pine and white fir. Usually at medium altitudes between the yellow pine and Engelmann spruce types.

*District 4.*—The principal species in mixture are western yellow pine, lodgepole pine, and western larch. Usually at medium elevations between the yellow pine and lodgepole pine or Engelmann spruce types.

*District 5.*—The principal species in mixture are yellow pine, sugar pine, incense cedar, and white fir. Usually at medium elevations on fairly favorable sites. Nearly always on north and east slopes or moist bottoms.

*District 6.*—The characteristic forest west of the Cascades, occurring as pure stands of Douglas fir, or Douglas fir mixed with hemlock, cedar, and other species such as Sitka spruce, Port Orford cedar, lowland fir, western white pine, silver fir, and rarely lodgepole pine.

**Douglas Fir-Spruce (DF-Sp).****District 4.**

A stand containing approximately 60 per cent or more of Douglas fir and Engelmann spruce in varying mixtures. Other species in mixture are western yellow pine, lodgepole pine, and

western larch. Usually at medium elevations between the yellow pine and the lodgepole pine or Engelmann spruce types.

**Larch-Douglas Fir (La-DF).** Districts 1, 4, and 6.

A stand containing approximately 75 per cent or more of western larch and Douglas fir, often with white fir in mixture. Larch is the key tree. The proportion of larch may vary from 10 per cent to practically pure.

*District 1.*—The principal species in mixture is yellow pine, occasionally with lodgepole pine, western white pine, lowland fir, western red cedar, or western hemlock. Usually at medium elevations, about the same as Douglas fir, but on more favorable sites. On less favorable sites than white pine. A mixture of 15 per cent of white pine would throw the classification to white-pine type. Twenty-five per cent yellow pine would class it as yellow-pine type.

*District 4.*—The principal species in mixture are yellow pine and lodgepole pine, white or lowland fir, and Engelmann spruce. Usually at about the same elevation as the Douglas-fir type, but on slightly more favorable sites.

**White Fir-Larch-Douglas Fir (WF-La-DF).** District 6.

A stand containing approximately 60 per cent or more of western larch, white fir, and Douglas fir, with some western yellow pine and lodgepole pine, but with yellow pine in the minority. Within its range western larch is the key tree. The proportion of each species varies greatly, from very little to practically pure. A prevalent type on the north and cool slopes within the yellow-pine zone; of secondary commercial importance and very variable mixture.

**Western Hemlock (WH).** Districts 1, 6, and 8.

A stand containing 50 per cent or more of western hemlock, exclusive of trees growing in partial shade, usually in mixtures.

*District 1.*—The principal species in mixture are western red cedar, white fir, and western white pine. The type usually occurs on sites suitable for western white pine, but old stands, from which the pine has nearly or completely disappeared, will be typed as western hemlock. A mixture of 15 per cent of white pine, however, will justify typing as white pine.

*District 6.*—The principal species in mixture are Douglas fir, lowland fir, silver fir, western red cedar, and (near the coast) Sitka spruce. Found west of the Cascades on sites suitable for Douglas fir or Sitka spruce. usually on areas from which these less tolerant species have largely or entirely disappeared.



*District 8.*—The principal species in mixture are Sitka spruce, Alaska cedar, western red cedar, and (in the Chugach region) mountain hemlock. A mixture of approximately 25 per cent or more of Sitka spruce would classify the type as spruce.

### Mountain Hemlock (MH).

Districts 1, 6, and 8.

A stand containing approximately 50 per cent or more of mountain hemlock (*T. mertensiana*). Other species common in the mixture are alpine fir, silver fir, Shasta fir, alpine larch (*L. lyallii*), white-bark pine, lodgepole pine, western white pine, and Engelmann spruce. At the higher elevations, usually near the upper limit of tree growth. Areas of mountain hemlock not capable of producing merchantable stands should be included in the subalpine type.

*District 1.*—The principal species in mixture are alpine fir, Engelmann spruce, and western white pine.

*District 6.*—Occurs only at the higher elevations. The principal species in mixture are silver fir, alpine fir, lodgepole pine, alpine larch, and western white pine.

*District 8.*—The principal species in mixture on the Tongass Forest is Alaska cedar. Frequently grows in pure stands. Reaches tidewater elevation on the Chugach Forest.

### Spruce (Sp).

Districts 1, 2, 3, 6, 7, and 8.

A stand composed chiefly of one of the species of spruce used for lumber production. Except in District 8, spruce should constitute at least 50 per cent of the stand.

*Districts 1, 2, and 4.*—In the Rocky Mountain region Engelmann spruce, sometimes with blue spruce on moist sites or at high elevations, may be pure, but is more often in mixture with alpine fir, lodgepole pine, limber pine, Douglas fir, and occasionally (in District 2) bristlecone pine. The type occurs at the higher elevations and on the moister sites.

*District 2 (Lake States and Black Hills).*—White spruce is the key tree. In the Black Hills it is usually nearly pure, while in the Lake States it is usually mixed with balsam fir, northern white cedar, tamarack, and occasionally black spruce and white pine. Approximately 50 per cent or more of white spruce should be present to justify designation as spruce type. Such stands are usually on wet soils but with good drainage.

*District 3.*—Engelmann spruce, sometimes with blue spruce, is usually mixed with alpine fir, cork-bark fir, Douglas fir, or bristlecone pine. The type occurs only at the higher elevations, usually near the upper limit of timberland.

*District 6.*—The type occurs chiefly on valley bottoms and benches on the west side of the Olympic and Coast Mountains,



with Sitka spruce as the key tree, usually in mixture with western hemlock, western red cedar, Douglas fir, and other species. The type usually contains at least 60 per cent spruce.

*District 7.*—Red spruce is the key tree, although small quantities of white spruce and black spruce may be present. In New England balsam fir and paper birch are the chief associated species, but spruce usually forms 75 to 90 per cent or more of the stand, and the type occurs chiefly on steep upper slopes where the soil is thin. In the southern Appalachians the mixture is sometimes confined to red spruce and southern balsam fir at the higher altitudes, with an increasing proportion of hemlock, northern hardwoods (especially yellow birch), hickory, buckeye, and cucumber with decrease in altitude. The type occurs at elevations of over 4,500 feet in the southern Appalachians and of over 3,250 feet in the Allegheny highlands of West Virginia. Stands containing less than 50 per cent of spruce and balsam fir will not be typed as spruce.

*District 8.*—Sitka spruce is the key tree in the coast region, with western hemlock, Alaska cedar, and western red cedar in mixture. The spruce usually constitutes a more or less broken overstory, with a dense stand of the more tolerant species below. A mixture of approximately 25 per cent of spruce justifies using the name of that species for the type.

### **Black Spruce (BSp).                      Districts 2 (Lake States) and 8.**

A stand containing approximately 80 per cent or more of black spruce, usually of pulp-wood size only. In the Lake States there is usually some northern white cedar, tamarack, or balsam fir in mixture. The type is usually confined to swamps with peaty soils.

### **Spruce and Hardwoods (Sp and Hdw).                      District 7.**

A stand composed of less than 50 per cent of red spruce in mixture with one or more species of the northern hardwoods. Hemlock is sometimes present. It occurs on sites intermediate between those of the northern hardwoods and the spruce types.

### **White Spruce-Birch (WSp-B).                      District 8.**

A stand composed chiefly of white spruce and white birch, with occasional trees of black cottonwood, balm of Gilead, and aspen. It occurs on lower slopes and flats on the Chugach Forest.

### **Tamarack.                      District 2 (Lake States).**

A stand containing approximately 80 per cent or more of tamarack, usually with some black spruce or northern white cedar in mixture. It occurs on wet ground or in swamps, and

is distinguished from the black spruce and northern white cedar types by the proportion of tamarack.

### Fir (F).

District 3, 4, 5, and 6.

A stand containing approximately 50 per cent or more of one or more species of the true firs. White fir, alpine fir, red fir, Shasta fir, noble fir, and silver fir, either in combination or singly, usually predominate, with lowland white fir in smaller quantities.

*District 3.*—A stand containing 50 per cent or more of white fir. The chief tree in mixture is Douglas fir, associated with Engelmann spruce, alpine fir, and cork-bark fir at the higher elevations, and with yellow pine at the lower elevations.

*District 4.*—A stand containing approximately 60 per cent or more of white fir, alpine fir, or lowland white fir, either in combination or singly, with a varying mixture of Douglas fir, Engelmann spruce, and lodgepole pine. It is found at varying elevations, depending on the exposure, within the Douglas fir and Engelmann spruce zones.

*District 5.*—A stand containing approximately 50 per cent or more of white fir or red fir, but not over 75 per cent of the latter species; often in mixture with western white pine, sugar pine, mountain hemlock, and lodgepole pine, the last scattered or in pure patches; occasionally mixed with Jeffrey pine, incense cedar, and Douglas fir. At the higher elevations and on cool, moist sites.

*District 6.*—A stand characterized by noble, silver, or red fir, either in mixture or singly. Other species in mixture are Douglas fir, western hemlock, mountain hemlock, western white pine, lodgepole pine, white fir, lowland white fir, western larch, and Alaska cedar (*C. nootkatensis*). It is the characteristic type of certain situations on the upper slopes of the Cascades, usually above Douglas fir and hemlock types on the west and above the yellow pine and white fir-larch-Douglas fir types on the east of the Cascades. The key trees are silver fir and noble fir in the northern part and red fir in the southern part of the district.

### Red Fir (RF).

District 5.

A stand containing at least 75 per cent of red fir (*Abies magnifica*) including Shasta fir (*A. magnifica shastensis*), usually at the higher elevations below the subalpine type.

### Subalpine (Alp).

Districts 1, 2, 3, 4, 5, 6, and 8.

A stand containing a varying mixture of subalpine species, no one of which is abundant enough to throw the stand into any of the types already described, or, rarely, pure stands. At the



upper limit of tree growth, usually unmerchantable because of poor form and small size, and of value for protective purposes only.

*District 1.*—The principal species are alpine fir, Engelmann spruce, lodgepole pine, white-bark pine, limber pine, mountain hemlock, and alpine larch.

*District 2.*—The principal species are alpine fir, Engelmann spruce, lodgepole pine, limber pine, and bristlecone pine.

*District 3.*—The principal species are Engelmann spruce, bristlecone pine, limber pine, and dwarf juniper.

*District 4.*—The principal species are alpine fir, Engelmann spruce, lodgepole pine, white-bark pine, and limber pine.

*District 5.*—The principal species are red fir, white fir, lodgepole pine, white-bark pine, western white pine, foxtail pine, and mountain hemlock.

*District 6.*—Usually characterized by alpine fir, but not necessarily containing a majority of this species; also has red fir, noble fir, lodgepole pine, white-bark pine, western white pine, mountain hemlock, and alpine larch. It is a type which does not produce saw logs.

*District 8.*—Characterized by mountain hemlock and Alaska cedar of small size and poor form.

### Redwood (R).

Districts 5 and 6.

A stand containing approximately 80 per cent or more of red-wood, usually with some Douglas fir, madrona, tan oak, and other smaller hardwoods. In situations at low elevations along the coast in California and southern Oregon.

### Cedar (C).

Districts 1, 2, 6, and 8.

A stand in which one or more species of cedar forms the most important commercial crop, although almost always there are other species present.

*District 1.*—Western red cedar predominates, with less than 15 per cent of white pine or 50 per cent of hemlock in the mixture. Usually occupies creek bottoms and lower slopes that could be producing white pine. Common associates are western hemlock, white pine, lowland white fir, and occasionally Douglas fir.

*District 2 (Lake States).*—Northern white cedar (*T. occidentalis*) is the key tree, and constitutes 75 per cent or more of the stand. Tamarack and black spruce often occur in mixture with the cedar. The type usually occupies shallow swamps on good soils, with little or no peat present.

*District 6.*—A mixed forest in which western red cedar is the most important species, usually comprising 40 per cent or



more of the stand. The usual associates are hemlock, lowland white fir, silver fir, Douglas fir, and sometimes Sitka spruce. It is found principally in valley bottoms on either side of the Cascades, but chiefly on the west side, contiguous to the Douglas fir or the western hemlock type.

*District 8.*—A mixed forest in which western red cedar, Alaska cedar, or the two together, constitute 50 per cent or more of the stand, with western hemlock and Sitka spruce in mixture. The presence of 25 per cent or more of Sitka spruce justifies typing as spruce.

### Cedar-White Fir (C-WF).

### District 1.

A stand composed of cedar and lowland white fir, the former nearly pure in patches; the latter predominant for the stand as a whole, with a considerable amount of Douglas fir, some yellow pine in groups on the knolls and as scattered individuals, and rarely, single western white pines. The type occurs on the Selway National Forest and the southern portion of the Clearwater National Forest south of the commercial range of white pine.

### Aspen (A).

### Districts 2, 3, 4, and 7.

A stand containing approximately 60 per cent or more of aspen, often nearly pure, but sometimes with the regional conifers or hardwoods in mixture. It occurs at medium to high elevations and usually on fairly moist sites. Even when aspen forms a nearly pure overstory, conifers, or tolerant hardwoods are often abundant as reproduction underneath; and, especially where there is no market for aspen, such stands may be mapped as young age classes of this understory.

*District 2.*—In the Rocky Mountains the type may or may not have an understory of Engelmann spruce, blue spruce, alpine fir, Douglas fir, or western yellow pine. In the Lake States aspen often forms nearly pure stands, but is also found with paper birch in mixture and with black and white spruces, jack, red, and white pines, and the tolerant hardwoods in mixture or as an understory.

*District 3.*—The aspen usually has an understory of Engelmann spruce, cork-bark fir, and alpine fir, indicating a spruce permanent type, or of Douglas fir and white fir, indicating a Douglas fir permanent type.

*District 4.*—The aspen is often pure, and may or may not have an understory of Douglas fir, Engelmann spruce, white fir, alpine fir, or, more rarely, lodgepole pine or western yellow pine.

*District 7.*—The type often has paper birch mixed with the aspen in the overstory, and usually has an understory of conifers and tolerant hardwoods. It is clearly a temporary type in most cases, and the cutting of the overstory of aspen reduces the amount of that species to small proportions in the succeeding stand, unless fire occurs. In mapping, no distinction will be made between *P. tremuloides*, *P. grandidentata*, and *P. balsamifera*.

#### White Birch and Aspen (WB-A).

Districts 2 (Lake States) and 7.

A stand containing approximately 60 per cent or more of paper (white) birch. It is distinguished from the aspen type by the proportion of birch, but otherwise is not markedly different.

#### Bottomland Hardwoods (Hwd).

Districts 6 and 8.

A stand consisting largely (usually 80 per cent or more) of any one or a mixture of the following species: Alder, black cottonwoods, bigleaf maple, Oregon ash. It is usually found on bottom lands or moist slopes at low elevations in western Oregon and Washington, and in Alaska where it is often a temporary type which is ultimately replaced by a coniferous forest.

#### Northern Hardwoods (N Hdw).

Districts 2 (Lake States) and 7.

A stand containing 50 per cent or more of yellow birch, sugar maple, and beech, with widely varying proportions of these species relative to one another. In the Lake States the type occurs on good or moderately good soils and frequently has elm, basswood, oaks, and conifers in mixture. In New England red maple, paper birch, red spruce, balsam fir, white pine, and hemlock may be present, and the type occurs at medium elevations on well-drained areas. In the southern Appalachians the type occurs at elevations of from 3,500 to 5,500 feet in the southern mountains and somewhat lower in the mountains of northwestern Virginia and West Virginia; and common associates are hemlock, white pine, chestnut, red oak, sweet birch, black cherry, basswood, buckeye, cucumber, and ash.

#### Mixed Hardwoods (Hdw).

District 2 (Lake States).

A stand composed of hardwoods, usually with basswood, white oak, and red oak predominating, but often with varying proportions of yellow birch, ash, maple, and elm intermingled.

**Cove (Cove).****District 7 (Southern Appalachians).**

A stand composed of many tree species, including those which require good soil for their best development, such as yellow poplar, red oak (*Q. borealis maxima*), basswood, cucumber, beech, and buckeye. All species typical of the region and altitude may be present. Variations include pure stands of hemlock and of yellow poplar. It occurs on moist sites, such as in ravines, coves, flats, and north slopes.

**Plateau Oaks (PIO).****District 7 (Southern Appalachians).**

A stand composed of a mixture of many species, but with a predominance of the oaks, particularly southern red oak (*Q. rubra*, L, formerly Spanish oak *Q. digitata*), black oak, scarlet oak, and post oak. Black gum, hickory, shortleaf pine, and Virginia pine are common associates. The type is characteristic of dry sites on the plateaus, usually below 1,000 feet elevation in the northern part of the region, but occurring at 2,500 feet or higher elevation in the southern mountains. It is distinguished from the cove type by the absence or relative scarcity of the better species, such as yellow poplar and red oak (*Q. borealis maxima*).

**Chestnut (Ch).****District 7 (Southern Appalachians).**

A stand in which chestnut predominates or, rarely, grows pure. Common associates are chestnut oak, red oak, white oak, black oak, scarlet oak, yellow poplar, hickory, black gum, sweet birch, basswood, sugar maple, and beech. Apparently the type will ultimately disappear through the killing of the key species by disease. The types replacing it will vary with the site.

**Chestnut Oak (ChO).****District 7 (Southern Appalachians).**

A stand containing approximately 40 per cent or more of chestnut oak, sometimes pure but more commonly in mixture with chestnut, beech, black oak, scarlet oak, Virginia pine, shortleaf pine, and southern red oak (*Q. rubra*, L.). It usually occupies southerly or dry northerly slopes and ridges at medium to high elevations for the region, but occurs nearly at sea level in the valley of the Potomac and farther north.

**White Oak (WO).****District 7.**

A stand in which white oak predominates. In the Appalachian, Cumberland, and Allegheny Mountains it occurs on benches and lower slopes and in coves. Associated species include nearly all of the common upland trees of the region. It is best developed below the altitudes of 3,500 feet in the southern part of the Appalachians and at lower elevations in



the north. It is distinguished from the cove type by the predominance of white oak and the relative scarcity of yellow poplar, northern red oak, hemlock, and other species requiring a moist, fertile soil for their best development.

In Arkansas a stand containing less than approximately 50 per cent of shortleaf pine, with a varying mixture of white oak, red oak, southern red oak, post oak, black oak, hickory, black walnut, black gum, black cherry, beech, and other species, but with white oak as the key tree and usually predominating. It occurs on all sites.

**Hardwood-Hammock (Hdw-H).**

**District 7 (Florida).**

A stand composed of water oak, magnolia, hickory, bay, cabbage palmetto, and other broadleaf trees, especially oaks, on slightly elevated strips along waterways. A heavy undergrowth of semitropical vines and ferns is present.

**Titi (Ti).**

**District 7 (Florida).**

A dense junglelike swamp along streams, composed of a great variety of species, all of which, except titi (*Cliftonia monophylla*), occur only scatteringly.













